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Early-Oligocene low-angle normal faulting in the Eastern Alps

Alberto Ceccato and Giorgio Pennacchioni
University of Padua, Department of Geosciences, Padova, Italy (alberto.ceccato.2@studenti.unipd.it)

During Early-Oligocenic cooling of the Rieserferner pluton (RFP, Eastern Alps) through amphibolite-greenschist facies temperature conditions, a set of shallowly (15-25°) E-dipping joints, epidote and quartz veins developed. These joint and veins were exploited as top-to-the-East normal ductile shear zones, then overprinted by a set of steeper brittle-ductile shear zones with the same orientation and kinematics. Strong fluid-rock interaction, feldspar destabilization and chlorite+white mica+calcite veins characterize these brittle-ductile mylonites. As a whole, the orientation, kinematics and meso-microstructural evolution of these shear zones are similar to that described for the Katschberg normal fault (KNF, Genser and Neubauer, 1989), a regional scale low-angle normal fault (LANF). Therefore, some genetic relationship between the two might be outlined.

The characteristics, timing and the comparison of this set of structures with the KNF allow us to investigate both regional geology topics and mechanical processes related to LANF, in particular:
1) The KNF is miocenic in age (23 Ma). Comparing field, microstructural and published thermo-chronological data, we infer that structures in the RFP developed between 30 and 26 Ma, defining, therefore, the first occurrence of exhumation tectonics in the future Tauern Window region. In addition, diffuse extensional structures might be responsible for the "regional E-down tilting" inferred from thermochronological data (Steenken et al., 2002).
2) Given the limited amount of accommodated strain, these structures might represent the incipient stages of deformation and nucleation (on brittle precursors) of a regional-scale LANF. Nucleation probably occurred at very low-angle, given the small amount of supposed "regional E-down tilting" (5°, Steenken et al., 2002) and the unlikely occurrence of rolling-hinge model rotations. The transition from shallow- to high-angle dips probably represents the evolution in geometry of fault system during footwall uplift and decreasing confining pressure. Veins and fluid-rock interaction suggest the occurrence of high pore-fluid pressure.
3) Different weakening mechanisms contributed to slip along misoriented planes: (i) reaction weakening processes in mylonites exploiting epidote veins; (ii) inherently weak quartz with respect to the host granitoid during quartz vein shearing; (iii) feldspar-to-mica reaction during later stage brittle-ductile mylonite development. The results of rheological models about shear zone deformation will be discussed focussing to the strength evolution and to the LANF-slip/seismicity conundrum.